# RECREATION USE INVENTORY

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by

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## Preface

Since this study was initiated the Bureau of Outdoor Recreation requested the National Research Council of the National Academy of Science to assess demand estimation for outdoor recreation. The Committee on Assessment of Demand for Outdoor Recreation was formed and its report Assessing Demand for Outdoor Recreation (1975) has been published. The report is generally excellent and should be reviewed by Forest Service land use planners and recreation specialists.

The technical report regarding economic models of recreational use (Smith, 1975) commissioned by the committee, however, does not review some recent methodological advances in modelling. In particular the work of Brown and Nawas (1973) and Gum and Martin (1975). Their work has been drawn into the discussion in this paper, leading to a recommendation to the Forest Service that differs from that which might be drawn from the Committee's report. Specifically, this paper concludes that on-site surveys are not necessary to estimate structural demand equation and resource values.

Two models are recommended in very generalized form. The first model recommendation is simply stated in terms of the additional variables that should be measured in state level surveys to make such surveys site specific and to identify demand. This model could be used to predict use and to value recreational resources. The second model is recommended to predict use response to changes in supply using time series analysis of use data and site characteristics.

## Summary

Three types of existing empirical models were identified, population specific, site specific, and population-site specific. The primary difference between the population specific and the site specific models is the population sampled. Smith (1975), however, states that the population specific model is useful for estimating the demand for a final consumption service (the activity) versus the demand for an input (the site) to the final consumption service. The position taken here is that the distinction is very important and it exists for the models Smith reviewed, but that it is not a necessary distinction among the empirical models that have been estimated. It has been shown that it is possible to estimate models of demand for activities and for sites from a survey of households in given populations, i.e. it is not necessary to conduct on-site surveys to estimate site demand and value (Gum and Martin 1975).

Thus, the recommendation is made that the national surveys proposed by the National Academy of Science Committee on Assessment of Demand for Outdoor Recreation Resources (NAS 1975) be made up of state level surveys, rather than regional, and that site and activity specific participation and cost information be gathered in addition to the household characteristics. This approach seems to be the most cost effective, both from the standpoint of the Forest Service and the other federal and state agencies involved in the provision of outdoor recreation opportunities. Such an approach would provide data for models to predict use and to estimate demands for activities and for sites.

The National Forests should gather data on recreational use that is site and activity specific for developed sites and dispersed recreational

use and maintain data records on the characteristics of existing sites. The data records on site characteristics should be expanded to include dispersed recreation sites. A list of site characteristics is presented but should be considered only as preliminary. As more is learned about the recreationist's recreational experience production process, the list of site characteristics (inputs to that production process) should be refined and revised. These data may then be used in a time series analysis to predict use response to opportunity supply changes.

## Recreational Use Inventory

### Introduction

National Forest planners need information on recreational demand [1/] and participation upon which to base decisions regarding land use, recreation facility investment, and recreation facility management. The need for demand estimates arises from three sources (Kalter and Gosse 1970). First, these estimates are required to efficiently allocate scarce resources. Demand estimates form the necessary basis for estimation of recreation resource values which, in turn, are necessary for making land use and investment decisions. A related issue is reimbursement policy. Estimates of price and income elasticities are needed to determine the effects of alternative reimbursement policies on welfare.

Second, recreational services provided by the National Forests are often presumed to contribute to regional economies. Information on recreational demand is necessary to estimate the recreational export component of regional economies.

Third, recreation is a consumer good that requires inputs for its production. The demand for recreational services in the National Forests creates a derived demand for land, labor, and capital. In order to estimate future resource requirements for alternative levels of National Forest recreation services, measures of the demand for the recreational services are needed.

The confusion of participation [2/] with demand has been common in recreational planning (Burdge and Hendee 1972). Participation, what is commonly observed, is the result of supply and demand forces (King and Richards 1974).

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1/ Demand is defined in this report, unless otherwise indicated, in its economic sense as a functional relationship between the quantity of recreation that will be consumed and prices, income, and preferences.

2/ Participation and demand are not symonymous. Participation is a measure of the flow of consumption of recreational services. It results from demand and supply forces.

Models for explaining and predicting participation have generally been such that the demand and supply forces were not separable. Participation forecasts from such models can be used only to show what the future holds given that previous demand and supply trends continue. In other words, they tell the planner what will happen if he continues the programs of the past and the demands of the public continue as they have in the past.

The inability to separate demand and supply in these forecasting models is a form of the identification problem. The identification problem was first recognized by Working (1927) in relation to estimation of statistical demand curves. It is now recognized as a general problem in the social sciences where the experimental approach is not possible. A small, but important, body of literature regarding identification as related to recreation demand has evolved since the late 1960's.

The problem addressed by the effort reported here was the development of a generalized recreational use forecasting model from which estimates of structual demand parameters could be made.

## Objectives

The objectives of the effort to contribute to the solution of problem were:

1) To review recreational visitor attendance models and categorize them by the nature of the population, data required, and the quantity (use) variable.
2) To develop a generalized recreational use forecasting model applicable to National Forest Situations.
3) To develop a schedule of data the Forest Service should collect.

Process

The process utilized in attempting to accomplish the objectives involved a review of the relevant literature to identify existing models. Then, based on this review and on a definition of the kinds of questions to be addressed by the potential model, the existing models were examined for applicability. Since the problem is a special case of market theory, this theory was reviewed with special attention to the identification problem which arises in empirical market analysis.

## The General Supply-Demand Model

The recreational use an area receives occurs because people want to engage in various activities, have the wherewithal to visit the area and engage in various activities, and because the area provides opportunities for people to engage in various activities. In other words, recreational use of an area is the result of demand and supply forces. In this sense, recreational participation is no different than the consumption of other goods and services

Because the participation or use that is observed is the result of demand and supply factors, single equation models used to estimate demand may not really express demand, but some combination of demand and supply factors, i.e., consumption. Thus, in order to estimate demand functions it is necessary to find some means of controlling for or specifying supply influences. Doing this is referred to as solving the identification problem; the problem of determining the separate effects of demand and supply on changes in consumption (recreational use).

To illustrate the general case[3/], take a demand function:

$$Q = a_1 + a_2P + a_3Y + U_1 \qquad (1)$$

[3/]The discussion of the identification problem is drawn from Hu, Teh-wei (1973)

Equation 1 indicates that the demand for the good (Q) is a function of its price (P), income (Y) and a random disturbance ($U_1$). For a marketed good, the price (P) is determined not only by suppliers of the good but also by consumers of the good. The amount demanded and the amount supplied, together, determine P. If data on consumption are used, prices and quantities represent equilibria of supply and demand. An equilibrium condition can be expressed as:

$$Q_s = Q \qquad (2)$$

The quantity demanded (Q) equals the quantity supplied ($Q_s$), at equilibrium. So the quantity consumed and the price of a good are simultaneously determined in a market. Therefore, the supply relation must be introduced.

$$Q_s = b_1 + b_2P + b_3C + U_2 \qquad (3)$$

Equation 3 indicates that the supply of the commodity($Q_s$) is a function of its price (P), cost of production (C) and a random disturbance ($U_2$). Equation 1, 2, and 3, together, make up a simultaneous equation model of the market for the good. It implies that quantities Q and $Q_s$ and price P are similtaneously determined.

The equilibrium equation or market clearing equation (2) makes it possible to simplify the model by substituting equation 2 into equation 3.

$$Q = b_1 + b_2P + b_3C + U_2 \qquad (4)$$

The substitution eliminates $Q_s$ and gives two equations with two unknowns.

In general, we have two kinds of variables in the model, those that are to be determined within the process modelled and those that are predetermined outside the process. The quantity demanded (Q) and the price (P) are detemmined by the market process for the good whereas the cost (C) and income are determined or considered to be determined outside the good's market. P and Q are referred to as endogenous variables and C and Y as exogenous variables.

The four equations make up the structural model and are referred to as structural equations with structural coefficients or parameters. The structural model is based on economic theory and can be used, therefore, to test economic hypotheses. In estimating such models from market data, it is useful to form a set of reduced form equations which are equations in which an endogenous variable is expressed as a function of the exogenous or predetermined variables. This set of reduced form equations is called the reduced form of the model

If equation 4 is substituted into equation 1 and P is solved for the result is:

$$P = \left(\frac{b_1 - a_1}{a_2 - b_2}\right) - \left(\frac{a_3}{a_2 - b_2}\right)Y + \left(\frac{b_3}{a_2 - b_2}\right)C + \left(\frac{U_2 - U_1}{a_2 - b_2}\right) \qquad (5)$$

If equation 5 is substituted into 1 and Q is solved for the result is:

$$Q = \left(\frac{-a_1b_2+b_2a_2}{a_2 - b_2}\right) - \left(\frac{b_2a_3}{a_2 - b_2}\right)Y + \left(\frac{a_2b_3}{a_2 - b_2}\right)C + \left(\frac{a_2U_2-b_2U_1}{a_2 - b_2}\right) \qquad (6)$$

Equations 5 and 6 are reduced form equations of equations 1 and 4. The coefficients of the reduced form equations are functions of the coefficients of the structural equations.

<u>Identification Problem</u>

Translating the reduced form coefficients to the structural coefficients can be difficult. Mathematically, this is the identification problem. The reduced form equation coefficients must be such that the structural coefficients can be identified. If there is a unique solution to the transformation from the reduced form coefficients to structural coefficients, the model is just-identified. If there is more than one solution the model is over-identified. The model is under identified if no solution exists.

To show the algebraic form of the identification problem, the reduced form model, equations 5 and 6, will be used. Suppose we use regression analysis to estimate the coefficients of equation 5 and 6, obtaining:

$$P = \hat{e}_1 + \hat{e}_2 Y + \hat{e}_3 C \tag{7}$$

and

$$Q = \hat{f}_1 + \hat{f}_2 Y + \hat{f}_3 C \tag{8}$$

where:

$$\hat{e}_1 = \left(\frac{b_1 - a_1}{a_2 - b_2}\right) \qquad \hat{f}_1 = \left(\frac{-a_1 b_2 + b_1 a_2}{a_2 - b_2}\right)$$

$$\hat{e}_2 = \left(\frac{-a_3}{a_2 - b_2}\right) \qquad \hat{f}_2 = \frac{-b_2 a_3}{a_2 - b_2}$$

$$\hat{e}_3 = \left(\frac{b_3}{a_2 - b_2}\right) \qquad \hat{f}_3 = \frac{a_2 b_3}{a_2 - b_2}$$

The identification problem is to solve for the structural coefficients a and b from the reduced form coefficients, $e_i$ and $f_i$. To solve for the structural coefficients, six unknowns, we need six equations.

First, notice that:

$$\frac{\hat{f}_2}{\hat{e}_2} = \frac{\dfrac{-b_2 a_3}{a_2 - b_2}}{\dfrac{-a_3}{a_2 - b_2}} = \frac{b_2 a_3}{a_3} = \hat{b}_2 \tag{9}$$

$$\frac{\hat{f}_3}{\hat{e}_3} = \frac{a_2 b_3}{b_3} = \hat{a}_2 \tag{10}$$

Therefore, we also obtain the solution value for $a_2 - b_2$, the denominator of each reduced form eqaution. This means:

$$\hat{a}_3 = (a_2 - b_2)\hat{e}_2$$

$$= (a_2 - b_2)\frac{\hat{f}_2}{\hat{b}_2} = \left(\frac{\hat{f}_3}{\hat{e}_3} - \frac{\hat{f}_2}{\hat{e}_2}\right)\hat{e}_2 \tag{11}$$

and

$$\hat{b}_3 = (\hat{a}_2 - \hat{b}_2)\hat{e}_3$$

$$= \left(\frac{\hat{f}_3}{\hat{e}_3} - \frac{\hat{f}_2}{\hat{e}_2}\right)\hat{e}_3 \tag{12}$$

Use $\hat{e}_1$, write

$$a_1 = \hat{e}(\hat{a}_2 - \hat{b}_2) - b_1 \tag{13}$$

Use $\hat{f}_1$, write

$$-a_1\hat{b}_2 + b_1\hat{a}_2 = \hat{f}_1(\hat{a}_2 - \hat{b}_2) \tag{14}$$

Substitute 13 in 14, obtaining

$$\{\hat{e}_1(\hat{a}_2 - \hat{b}_2) - b_1\}\hat{b}_2 + b_1\hat{a}_2 = \hat{f}_1(\hat{a}_2 - \hat{b}_2)$$

$$\hat{e}_1(\hat{a}_2 - \hat{b}_2)\hat{b}_2 - b_1\hat{b}_2 + b_1\hat{a}_2 = \hat{f}_1(\hat{a}_2 - \hat{b}_2)$$

$$b_1(\hat{a}_2 - \hat{b}_2) = \hat{f}_1(\hat{a}_2 - \hat{b}_2) - \hat{e}_1\ \hat{b}_2(\hat{a}_2 - \hat{b}_1)$$

$$b_1 = \hat{f}_1\ \frac{(\hat{a}_2 - \hat{b}_2)}{\hat{a}_2 - \hat{b}_2} - \hat{e}_1 b_2$$

$$\hat{b}_1 = \hat{f}_1 - \hat{b}_2\hat{e}_1 \tag{15}$$

Then substitute 15 in 13

$$\hat{a}_1 = \hat{e}_1(\hat{a}_2 - \hat{b}_2) - \hat{b}_1 \tag{16}$$

We now have solutions for the $a_i$ and $b_i$ based on the $e_i$ and $f_i$, equations 9, 10, 11, 12, 15, and 16. This is an example of a model that is just-identified.

Suppose that equation 4 did not include cost, C. Then equations 5 and 6 would not include C. It would be possible to solve for $b_2$ by dividing the reduced form coefficients of Y. But $a_1$, $a_2$, $a_3$ and $b_1$ could not be obtained. This means that equation 1 and equation 4 (without C) are under-identified, because their structural coefficients cannot be estimated. When any structural equation is under-identified, the model is said to be under-identified.

Another possibility is overidentification. Say we add a taste variable, T, to the demand equation

$$Q = a_1 + a_2P + a_3Y + a_4T = U_1 \tag{17}$$

but make no change in supply equation 4.

$$Q = b_1 + b_2P + b_3C + U_2 \tag{18}$$

In this case the T variable is added to each reduced form equation

$$P + \left(\frac{b_1 - a_1}{a_1 - b_2}\right) - \left(\frac{a_3}{a_2 - b_2}\right)Y + \left(\frac{b_3}{a_2 - b_2}\right)C$$

$$+ \left(\frac{b_2a_4}{a_2 - b_2}\right)T + \left(\frac{U_2 - U_1}{a_2 - b_2}\right) \tag{19}$$

$$Q = \left(\frac{-a_1b_2 + b_2a_2}{a_2 - b_2}\right) - \left(\frac{b_2a_3}{a_2 - b_2}\right)Y$$

$$+ \left(\frac{a_2b_3}{a_2 - b_2}\right)C + \left(\frac{a_4}{a_2 - b_2}\right)T + \left(\frac{a_2U_2 - b_2U_1}{a_2 - b_2}\right) \tag{20}$$

then: $\hat{e}_4 = \left(\frac{b_2a_4}{a_2 - b_2}\right)$ and $\hat{f}_4 = \left(\frac{a_4}{a_2 - b_2}\right)$

We can obtain:

$$b_2 = \frac{f_4}{e_4}$$

But we can also obtain $b_2 = \frac{f_2}{e_3}$, since the structural coefficeints are all dependent on the value of $b_2$. The two possible values for $b_2$ mean different possible solution values for all of the structural coefficients. So the solutions are not unique andthe model is over identified. Even though multiple solutions are possible the model can be estimated.

The conclusion is that we desire a model that is just identified or over identified. These two are collectively referred to as identified models.

The next question is what methods can be used to achieve an identified model. There are two principles used to identify a simultaneous equation model. The first is that the model, to be locigally complete, should have the number of endogeneous variables equal to the number of structural equations. For this example, equations 1, 2, and 3 are the structural equations of the model with three endogenous variables, Q, $Q_S$, and P. The second principle is that the necessary restrictions on the equations must be known in advance of attempting to estimate the model. That is, it should be known each equation is sufficiently distinctive from the others.

Using the model presented here, equation 1 and 4, we can rewrite it in a second form:

$$Q = a_1 + a_2P + a_3Y + a_4C + U_1 \qquad (21)$$

$$Q_2 = b_1 + b_2P + b_3C + b_4Y + U_2 \qquad (22)$$

The necessary prior restriction for the demand equation is that $a_4 = 0$ and, for the supply equation $b_4 = 0$. These restrictions imply that cost of production plays no part in demand and that consumer income plays no

part in supply. This type of restriction is referred to as a restriction on the parameters of the structural equations. Another type of restriction on equations is a restriction on the disturbance terms, $U_1$ and $U_2$. Disturbance restriction means that we may have prior knowledge that the relative shifts in one of the relationships are greater than the relative shifts in the other, with the shifts being uncorrelated. For example, if it is known that the supply relation has shifted, to a greater relative extent than the demand relationship, the demand relationship is identified.

Dispensing with algebra, the identification problem may be expressed in words. Since equilibrium price and quantity are determined by supply and demand, in order for different observed equilibria to trace out a demand curve it is necessary that demand remain constant while supply shifts. This is shown in Figure 1. The reverse is true if the supply curve is of interest. The difficult situation is one in which both supply and demand shift. When this is the case, it then becomes necessary to consider the relation of relative shifts in the two functions.

The shifts in demand and supply of concern in empirical studies are shifts among the analytical or sampling units used. These units differ in nature depending on the analytical approach taken.

Time Series vs. Cross-Section Analysis

In empirical estimation of strucutral models, two general types of analysis used are time series and cross-section. Cross-section analysis has been most commonly used in studies or recreational use. The main reason is that accurate periodic estimates of recreational use have not been available.

Time series analysis is based on data obtained at various points of time. These data are market data. The sampling unit or analytical unit is the time period, a year, quarter, month, etc. The different periods of time

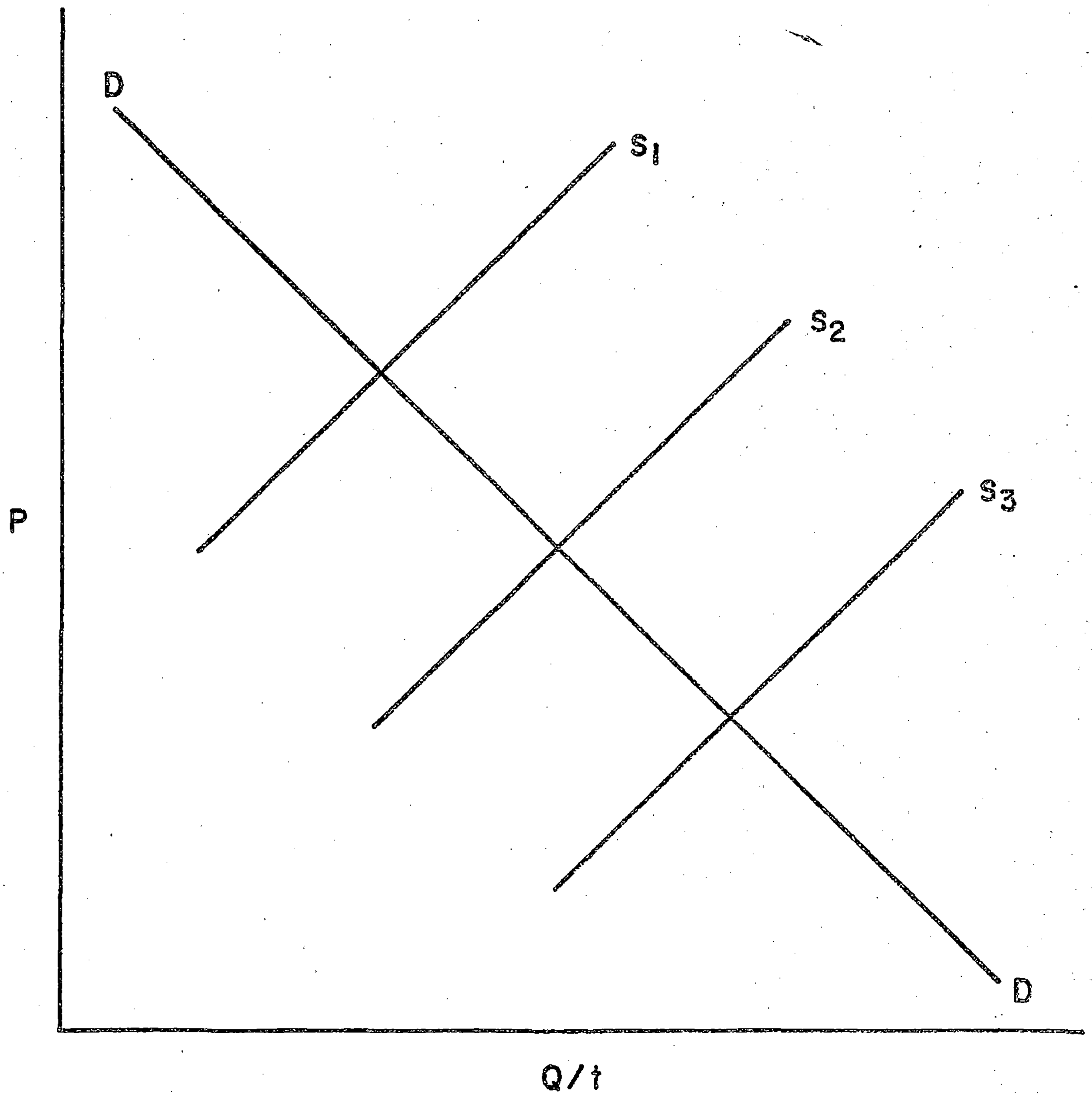


Figure 1. Shifting supply tracing out a constant demand function.

are assumed homogeneous. A typical problem in time series analysis is multicollinearity among independent variables. For example, income, leisure time, and education have all been increasing over time. The multicollinearity can be so great that simply using time as a predictor variable will often produce an estimating equation as statistically "good" as one utilizing variables with some logical connection with recreational use. Simply using a time variable is the same as extending historical recreational use trends into the future. Multicollinearity can be handled in a number of ways depending on the specific application. These include the following (Hu, 1973):

1. Estimate parameters for one or more variables from cross-section analysis
2. Drop variables
3. Change the functional form of the equation
4. Use a longer time period (Larger sample)

Cross-section analysis is based on data obtained from or about economic units at a point of time. In the case of recreational use models, the economic units most often used are the household or the individual. The household or individual, then, is the sampling unit or analytical unit. A basic assumption of cross-section analysis is that, except for the explanatory variables examined, the consuming units are homogeneous. Put another way, it is assumed that a relatively poor household would consume as much recreation as a relatively rich household if the poor household's income increased to that of the rich household.

The important distinction between these two approaches with regard to the identification problem is their different analytical and/or sampling units, markets and time periods in time series analysis and economic units in cross-section analysis.

When taking a time series approach, market equilibria of price and quantity at different points of time are observed. The various equilibria could result from shifts in both supply and demand, shifts in demand alone, or shifts in supply along. In some cases, it may be possible to ascertain in advance whether demand or supply has remained constant or whether one has changed more than the other. Then changes in equilibria may be used to estimate either supply or demand functions, respectively. The important point is that shifts in supply and demand over time are of concern.

In cross-section analysis, the sampling and analytical unit is an economic unit. For consumer goods, such as recreation, the economic unit is the individual or household. If we define a market population for a good, cross-section analysis is concerned with explaining variation in consumption among the individuals or households in that market. This means that differences in supply among the households are necessary to trace out a demand curve for the good and demand must be relatively stable across the households in the population. Any household's consumption at a given price represents the intersection of the household's demand curve with the supply curve it faces. Thus, we have, for each household observed, one point on that household's demand curve and one point on the supply curve it faces. Any single consumer cannot influence the price of the good by varying the amount purchased. Thus, the supply curve facing the individual consumer is perfectly elastic. If all consumers in a market face the same price, the usual condition, then the differences in quantities of the good consumed among households trace out a perfectly elastic supply curve. This is shown in figure 2.

If we sample these consumers and attempt to explain the differences in the quantities consumed using consumer characteristics, we will be explaining shifts in demand, not estimating a price-quantity relationship. Since there

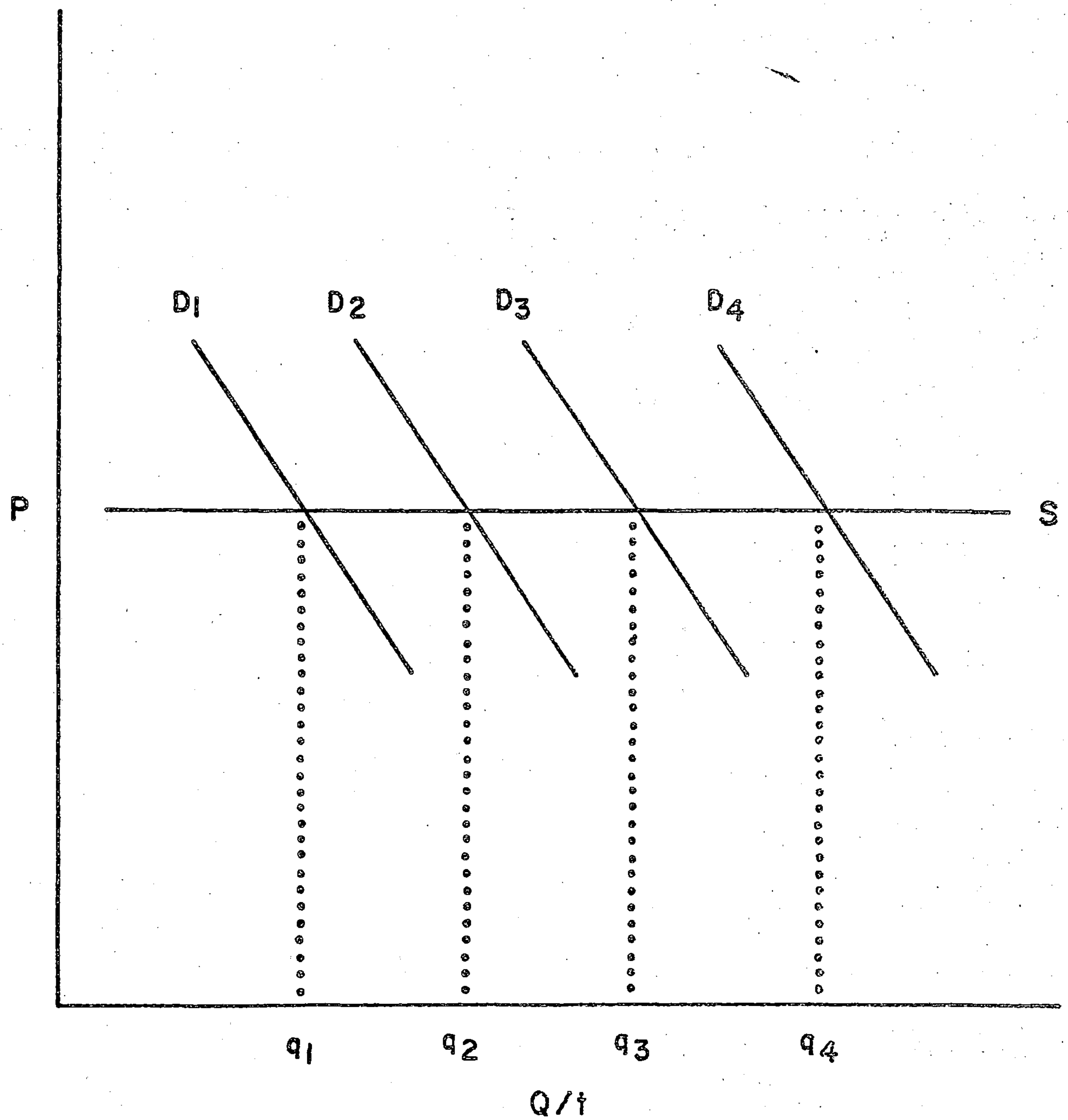


Figure 2. Consumption quantities of four consumers tracing out the supply curve facing them.

is no price variability among consumers no price-quantity relationship can be estimated. Because supply is constant among consumers and all face the same price, a price-demand curve is not traced out, i.e., identified.

In this situation, if the usual approach was taken of attempting to explain and predict quantity of recreation consumed using income and other consumer characteristics, the equations estimated would be Engel's curves. Since supply is constant, variations in consumption among consumers must be due to differences in demand among consumers. Thus, although a price demand relationship cannot be estimated, the analysis does involve the demand side of the market.

All is not lost, however, with regard to achieving identification of a demand relationship with cross-section analysis. Additional markets could be defined and, because of differential transfer costs (transportation, etc), different prices might exist in the different markess. This situation is shown in figure 3. The consumers in each market face a different supply/price situaticn. The different supply situations trace out the demand curve. If only transfer costs are included in the model, then an assumption of the model is that demand is homogeneous among markets. This assumption, however, can be made less heroic by introducing other consumer variables relevant to explaining consumption behavior. It is important to note that the commodity or service should be well-defined and homogeneous.

In actual empirical estimation, two approaches may be taken. First, market aggregates might be used. That is, mean consumption quantities in each market with corresponding prices (market equilibria) and mean values for other independent variables, would be used as the data points or observations.

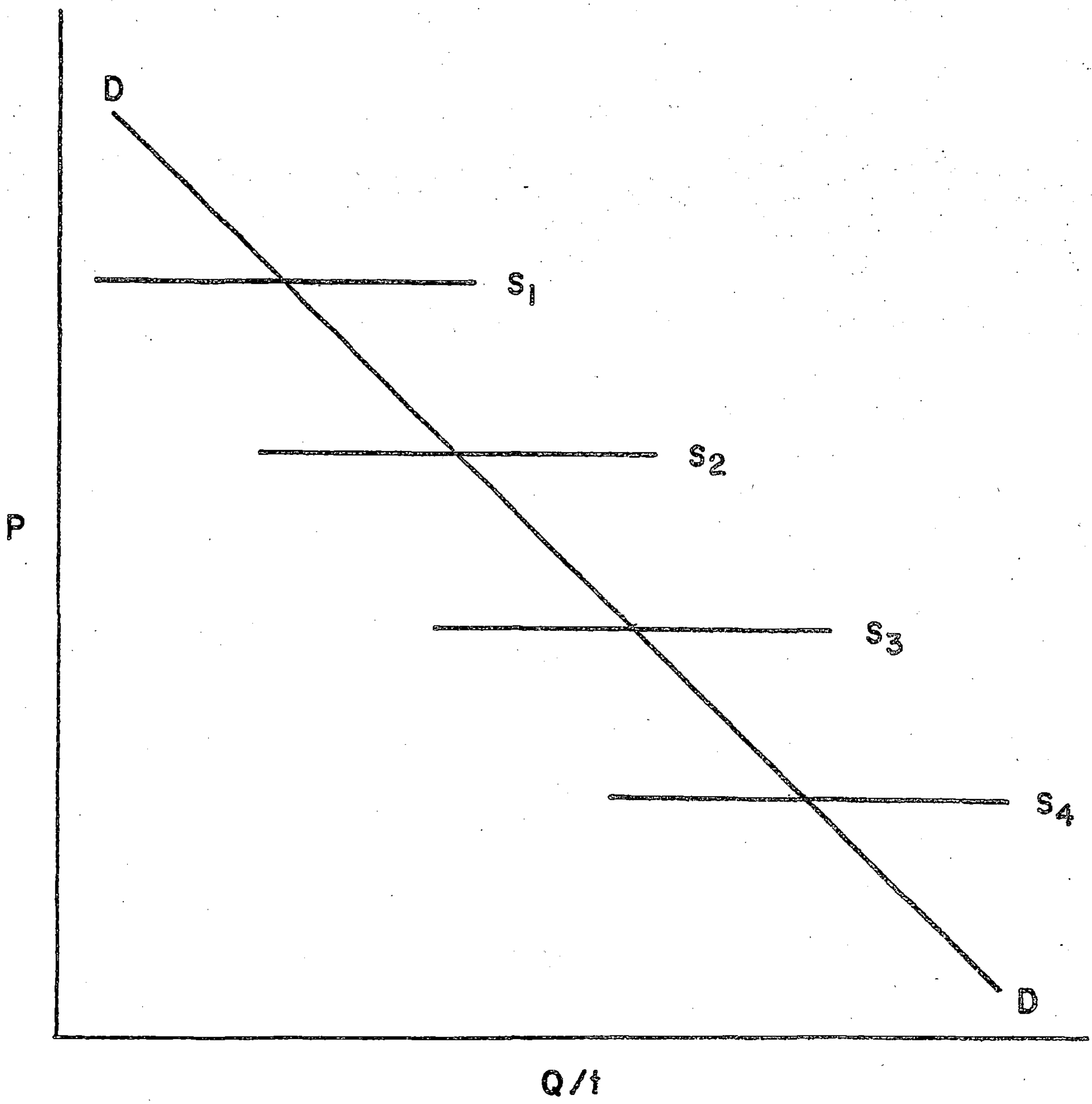


Figure 3. Four market areas with different supply/price levels tracing out constant demand function.

Or, a disaggregate approach could be taken wherein a sample of individual consumers was used. The disaggregate approach means a larger sample size is possible; reducing problems of possible multicollinearity among independent variables (Brown and Nawas 1973; Gum and Martin 1975).

When a time series approach is used an aggregate market analysis is required because data is available only for markets not for individual consumers. Again, variation in supply over time is necessary to trace out a demand curve and the demand for the product would have to be stable. The latter condition is seldom the case, leading to the identification problem.

# REVIEW OF VISITOR ATTENDANCE MODELS

Models used to forecast recreational attendance and/or participation and to estimate demand have been reviewed by a number of authors (Cicchetti 1972; Cicchetti, Fisher, and Smith 1972; Cicchetti, Smith, Knetsch, and Patton 1972; Wilkinson 1973, Moeller and Echelberger 1973; and Smith 1975). Some models are based on an economic approach and others on a systems approach. Only models based on eonnomic theory will be discussed. Availability of data has had an effect on the development of empirical eoonomic models of recreational participation. Although one of the purposes here is to recommend the kinds of data the Forest Service should collect for use in predicting recreational use and estimating demand, a review of existing empirical models in light of Forest Service needs is instructive.

Cicchetti, Fisher, and Smith (1972) developed a taxonomy of economic models in this field that provides a basis for categorization of models. The categories presented here represent a slight modification of their scheme.

## Population Specific

These models are represented in the various national and state surveys undertaken to estimate and predict recreational use as a function of consumer characteristics. Most are reduced form equation models that are under identified. The typical sampling unit is the household or individual. The quantity variable is the amount of participation in a given activity. Equations are estimated for all relevant activities. The location of the participation is not specified in these models.

Attempts have been made to provide identification of these models by the use of aggregate supply characteristics. The effectiveness of these attempts is questionable. One model used consumer and participation data

from the national recreation survey and added aggregate measures of supply available by county, state, census division and region. This approach does bring some of the effects of supply into the reduced form equation. But, because of the aggregate nature of the supply variables, individual demand relationships could not be identified. However, the reduced form equation estimated is more correctly specified by the inclusion of supply variables emen though they are aggregate in nature. To provide for identification sufficient to estimate a structural demand equation it is necessary to account for the variation in supply among individuals. (Cicchetti, Smith, Knetsch, and Patton 1972). Kalter and Gosse (1970) used national recreation survey data and regional aggregate supply variables. This approach to identification ignores intraregional variations in supply among individuals and assumes demand does not vary among regions, variations in demand can be controlled for through the introduction of demand shifting variables, or variations in demand are relatively less than supply variations. The basic issue with regard to identification is the first point, assuming no variation in supply among individuals within a region.

In order to achieve identification using cross-section data gathered through surveys of households,it is necessary to obtain from the respondents the location of their recreational activities and costs of participation. This has not been done in national surveys. There are a number of reasons for this. First, if the survey attempts to gather information for the preceding year's activity, memory decay is a very significant factor. Some surveys have been made at quarterly intervals to overcome memory decay problems. (ORRRC 1962). The experience of the author is that three month intervals may be too long for accurate cost recall by the respondent. On the other hand, such an interval may be sufficiently short to rely on the respondent's estimate of the "Usual on-site costs" per day. Estimates

of transportation costs to various locations could be calculated based on information about the respondent's vehicle and other recreational equipment.

Another reason for the lack of cost and location of activity information in the national surveys is that they are not designed with a basis in economic theory. A third reason may have been a belief that the costs of gathering the additional items of information would be too high.

A state level study (Martin, Gum, and Smith 1974) has been done which falls in the population specific category but which includes cost and location information so that the demand relationship was identified. A sample of the general population of household in Arizona was surveyed, via mail,and information on household characteristies, participation in various activities in various regions of the state, and costs of participation were obtained. The mail survey reduced the costs of data collection well below those of a personal interview survey. A weakness of the study was that the budget restricted the researchers to a single mailing of the survey instrument. Thus, the rate of response was low, 19 percent. Recent research, however, has shown how response rates close to those obtained in personal interview surveys can be achieved by mail surveys (Dilman, et.al.).

Mail surveys can be used to reduce costs of data collection and recall problems can be reduced by using a combination of respondent supplied location and usual on-site cost information and estimates of transportation costs base on location and vehicle information. Thus, there is apparently no reason to not achieve identification of the demand relationship in population specific models. However, one operational problem exists. The locations of activities must be aggregated to some extent to keep the recall problem and the transportation cost estimation within reasonable bounds.

This is extremely difficult in national surveys where the desired sampling precision,within cost constraints, can be achieved only by sampling large regional populations. For example the nation was stratified into only four regions in the national surveys that have been conducted. The use of the less expensive mail survey technique could provide the opportunity to use finer stratification of the national population. Perhaps the most reasonable unit is the state. The BOR could coordinate state surveys with the financing coming from BOR, other federal agencies, and the states.

Within states, the problem of identifying locations is more manageable than in large regions of the nation. The basic condition for definition of locations would seem to be a priori knowledge of name identification by the general population. Various sections of a state with recreational opportunities are usually identified by name in the public's mind. For example, in Arizona the name White Mountains means a fairly well defined section of the state to an Arizona resident. The identification of locations can be further enhanced through the use of maps in the survey instrument.

In summary, it would be possible to estimate recreation participation forecasting equations and demand relationships from population specific models. The additional costs of gathering the additional data do not seem large.

Site Specific

Cicchetti, Fisher and Smith, (1972) identify two separate site specific categories of models. One category involves the site as the observational unit (site specific, area), and the other the user (site specific, user)[4/].

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4/ In the Cicchetti taxonomy the definition of a site is not clear. It is possible for a site to take on whatever dimensions seem reasonable for the particular problem. For example, an individual campbround is sometimes considered a site and a geographical aggregation of sites as an area. In the context here, both of these will be called sites.

This distinction is based on the degree of data aggregation. In both models the on-site user is sampled, but in the one model the dependent variable is use of the site per origin zone and the independent variables are origin-zone averages, whereas in the other model the dependent variable is participation per user and the independent variables are individual's characteristics. Because the distinction is primarily on the level of data aggregation they are lumped into one category here. It should be noted, as well, that a model utilizing a sample of a general population can be made site specific as indicated above. The differentiation of the models then comes down to being based on the population sampled - a general population sampled at place of residence or a user population sampled on-site.

At a given site, users incur differing costs of participation due in large part to differences in travel costs. The so-called site-specific area models have aggregated users by distance zones or origin zones. Each zonal population forms a different supply/price situation as shown earlier in figure 3. The dependent variable is use per origin zone. In the estimation of such models for a given site/activity combination, the origin zones are the analytical units and are aggregates of individual users. The result is a small sample size and problems of multicollinearity between a distance variable and travel costs. Brown and Nawas (1973) have demonstrated the effect of such aggregation on the specification of the demand relationship and show the advantage of a disaggregate approach. In the disaggregate approach the dependent variable is the amount of participation in the activity at the site per user from a given origin zone.

For identification of the demand relationship to be achieved using the disaggregate approach, variations in travel costs per user among users must exist within each origin zone and the variations in travel costs should

not be caused by significant variations in the kind of recreational experience to which the recreational resource is an input. One way to ensure this is to include only transportation costs calculated on the basis of vehicle type and distance. If other costs such as lodging and food are included, then costs may be related to the kind or quality of the recreational experience involving the given activity. Such costs may be used to stratify users to take into account qualitative differences in the recreation experience.

It is but a small jump to complete the disaggregation to the point where the users are not stratified by origin zone. In this situation it is especially important the variations in travel cost represent different supply situations so that the demand relationship is traced out. This was the approach taken by Sublette and Martin (1975) in their study of National Forest sites in Central Arizona.

A drawback of the site specific models is the expense of the on-site survey. If all users were required to register and the requirement was enforced, mail surveys of users could be used.

The real distinction between the population specific and site specific models as categorized by Cicchitti et al. (1972), the preceding discussion shows, is primarily based on where the sampling takes place, off-site or on-site. The off-site sample can be used to derive site specific information. The on-site sample, however, cannot furnish information about non-users of a specific site that might be useful in identifying reasons for their nonuse and the existence of excess demand for a site.

Population and Site Specific

The population specific and the site specific models can be combined. The general population in the site's market area is sampled to provide information to estimate equations to predict the number of trips per household to a site during which a given activity will take place. The user population is sampled on-site to provide information to estimate

equations to predict the duration of the activity per trip. Such a model was estimated for the Mogollon Rim Area of Arizona (King and Richards 1975).

In estimating trip prediction models from general population surveys, the usual practice is to use a two step approach (Smith 1975). The first step is the estimation of a conditional probability equation to predict the probability a household would take at least one trip or the percentage of households that will take a trip. Then a conditional trip equation is estimated to predict the number of trips taken by those who take at least one. The reason for this approach is statistical. An underlying assumption of least-squares regression is that the dependent variable is unbounded (Godlberger 1964). When the dependent variable is bounded and a large proportion of the observations of it are at the bound, least squares estimation is biased. The situation described fits that of estimating number of trips emanating from a given population. The dependent variable is bounded at zero and most members of the population fall at the bound. The two step approach, however, runs into a problem of low degrees of freedom when the areas and populations of concern are substate regions. Given reasonable sample sizes, the number of households from a population center taking at least one trip to an area within a state is quite low. Thus, estimation of the conditional trip equation may be impossible. In this situation, the dependent variable, number of trips per household, can be normalized, through appropriate transformation, overcoming the bias of least squares estimation.

In estimating the conditional trip equation, the identification problem and its solution are the same as discussed in regard to population specific models. The trip or activity duration equations estimated from on-site data can also be identified as described with regard to site specific-models.

In using the combined approach it is necessary that the on-site survey be taken within a reasonable period of time of the general population survey in order to combine the estimates of trips and trip duration to arrive at a time measure of participation. The time interval must be short enough that no shift in aggregate demand or supply would be expected.

The combined model has the drawback of the site specific model, the expense of the on-site survey.

## A Recommendation

To make a recommendation regarding a generalized recreational use forecast model applicable to National Forest decision situations it is necessary to consider the nature of those situations. Decisions may be classified along at least two dimensions. The first is the level of decision within the Forest Service organizational structure, national, regional, forest, and district levels. A second dimension is the nature of decisions in terms of policy, allocation, and site-specific resource provision and management (National Academy of Sciences 1975). This dimension includes the three decisions listed above, land use, recreational facility investment, and recreational facility management. The two dimensions do not necessarily have a one-to-one relationship. Since the nature of the decisions is more stable than the organizational levels at which they may be made the second dimension will be used.

### Policy Decisions

Policy decisions involve the place of recreation in the context of national social and economic policy and, for the Forest Service specifically, the place of recreation in the context of the contributions the National Forests can make to national social and economic goals. These are the decisions that will be or are being made in the Forest Service implementation of the Resources Planning Act (RPA). In general, these are decisions regarding the goals to which all the resources avialable to and managed by the Forest Service will be allocated.

For these kinds of decisions, measures of broad national trends in recreation demand and other social and economic phenomena are needed. Precise quantitative estimates of many of these phenomena cannot be made,

but imagination and creativity must be used in the interpretation of the observable characteristics of such trends.

For overall national outdoor recreation policy planning, a national survey of participation every five years has been called for (National A Academy of Sciences 1975). The Forest Service should cooperate in these surveys and be ready to make suggestions regarding their design. In particular, it would be in the interest of the Forest Service to encourage the development of a national forecasting model that is population specific and site specific and which meets sampling precison requirements at a state level of stratification. The use of only four regions, as in past national surveys, seriously reduces the usefulness of the results, especially in the very large and diverse western region.

Policy decisions are made at levels below the national level. For example, the first stage in land use planning for a National Forest planning unit usually involves the establishment of land use objectives for various management units within the planning unit. These decisions establish the framework of objectives within which the management plans for the management units are developed. Information needs for these decisions are much less aggregative than those for national policy planning, but less detailed than those needed for management plan development. Again, state level models of recreational participation and demand as discussed above, would be most useful.

Since the basic recommendation is for cooperation of the Forest Service with other federal agencies and state agencies in national surveys useable at the state and area level, the data to be gathered directly by the Forest Service would be limited to National Forest recreation opportunity supply variables and use data.

The supply variables should include the following:

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| location | type of facilities |
| size | investment cost |
| elevation | vegetative cover |
| access condition | auxiliary services & facilities |

Recreational use data should also be collected by activity and site. The author's limited experience indicates that insufficient attention has been given to the measurement of recreational use of the National Forests. It is not clear whether this lack of effort arises from budgetary constraints, inertia, or failure to recognize recreation management as a legitimate function on the National Forests. Nevertheless, accurate and valid estimates of annual recreation use, by site and activity, could be very useful in identifying trends.

Allocation Decisions

Allocation decisions may also be made at all organizational levels. These decisions are defined as those typically involving choices of kinds and amounts of recreational resources and facilities to be provided. To make such choices, measures of the economic value of different uses of the resources are especially useful to the decision-maker.

The basis for estimating recreational resource value is the demand function for the resource. This means that a model of use that provided for estimation of the structural demand equation is also necessary. In other words, the model must provide for the identification of demand. The disaggregated site specific model used by Martin, et. al., (1974) is applicable to this problem. The data for estimation of such a model could be obtained from the recommended state surveys of households wherein participation data are site specific and activity specific.

In addition to value estimates, allocation decisions require predictions of the probable consequences, levels of recreational use, of alternative actions. Prediction of use, in this situation, involves predicting the consumption response to additions or deletions to the supply of recreational opportunites. One approach is to estimate the demand for and use of a similar existing site and apply it to the proposed supply addition or deletion. An application of this representative site approach was used by Sublette and Martin (1976) to estimate values for existing sites not sampled in their study. For this approach to be applicable, the estimated demand functions must include effects of site substitution. Such effects were successfully included in the demand function estimated by Martin, et. al. (197 ).

A concern in using the representative site approach is the degree of representativeness. Our lack of knowledge about the recreational experience production process increases the probability of achieving only a low degree of representativeness. Models estimating use as a function of supply characteristics could be used to overcome this problem. One such model has been estimated for TVA lakes (Seneca, Davidson, and Adams 1968). The estimation of such models requires accurate estimates of site use by activity and opportunity supply characteristics.

Management Decisions

These decisions are those made in the management of an existing site. Such questions as carrying capacity, effects of alternative use rationing mechanisms, and activity opportunities to be provided fall in this category. Because of the extreme site specificity of these questions, data gathered from visitors on-site are necessary. Such studies are typical of those that have been done for and by the Forest Service. Since these questions involve prediction of use only to a limited extent, they will not be discussed further.

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